What is claimed is:

[Claim 1] 1. A light emitting diode (LED) structure, having electrostatic discharge (ESD) protection function, comprising:

a substrate;

a patterned semiconductor layer, disposed over the substrate, wherein the patterned semiconductor layer comprises:

a first type doped semiconductor layer;

a light emitting layer, disposed over a portion of the first type doped semiconductor layer; and

a second type doped semiconductor layer, disposed over the light emitting layer, wherein the first type doped semiconductor layer, the light emitting layer and the second type doped semiconductor layer of the patterned semiconductor layer are defined into at least a first island structure and a second island structure;

a first electrode, connected between the first type doped semiconductor layer of the first island structure and the second type doped semiconductor layer of the second island structure; and

a second electrode, connected between the second type doped semiconductor layer of the first island structure and the first type doped semiconductor layer of the second island structure, wherein a LED is formed by the first electrode, the second electrode and the first island structure, and a shunt diode is formed by the first electrode, the second electrode and the second island structure, wherein the shunt diode is connected in parallel to the LED with an inverse bias compared to the LED.

[Claim 2] 2. The LED of claim 1, wherein the substrate comprises aluminum oxide, silicon carbide (SiC), zinc oxide (ZnO), silicon (Si), gallium phosphide (GaP), or gallium arsenide (GaAs) substrate.

[Claim 3] 3. The LED of claim 1, wherein the first type doped semiconductor layer comprising:

a nucleation layer, disposed over the substrate;
a buffer layer, disposed over the nucleation layer; and
a first confinement layer, disposed over a portion of the buffer layer.

[Claim 4] 4. The LED of claim 3, wherein a material of the nucleation layer comprises $Al_eIn_fGa_{1-e-f}N$, e, $f \geq 0$; $0 \leq e+f \leq 1$.

[Claim 5] 5. The LED of claim 4, wherein the nucleation layer is doped with an N-type dopant or a P-type dopant.

[Claim 6] 6. The LED of claim 3, wherein a material of the buffer layer comprises $Al_cIn_dGa_{1-c-d}N$, c, $d \geq 0$; $0 \leq c+d < 1$.

[Claim 7] 7. The LED of claim 6, wherein the buffer layer is doped with an N-type dopant.

[Claim 8] 8. The LED of claim 3, wherein a material of the first confinement layer comprises N-type doped $Al_xIn_yGa_{1-x-y}N$, x, $y \geq 0$; $0 \leq x+y < 1$; $x > c$.

[Claim 9] 9. The LED of claim 1, wherein the light emitting layer comprises doped $Al_aIn_bGa_{1-a-b}N/Al_xIn_yGa_{1-x-y}N$ quantum well structure, a, $b \geq 0$; $0 \leq a+b < 1$; x, $y \geq 0$; $0 \leq x+y < 1$; $x > c > a$.

[Claim 10] 10. The LED of claim 9, wherein the light emitting layer is doped with an N-type dopant.

[Claim 11] 11. The LED of claim 9, wherein the light emitting layer is doped with a P-type dopant.

[Claim 12] 12. The LED of claim 1, wherein the light emitting layer comprises undoped $Al_aIn_bGa_{1-a-b}N/Al_xIn_yGa_{1-x-y}N$ quantum well structure, a, $b \geq 0$; $0 \leq a+b < 1$; x, $y \geq 0$; $0 \leq x+y < 1$; $x > c > a$.

[Claim 13] 13. The LED of claim 1, wherein the second type doped semiconductor layer comprises:

a second confinement layer, disposed over the light emitting layer; and

a contact layer, disposed over the second confinement layer.

[Claim 14] 14. The LED of claim 13, wherein the second confinement layer comprises $Al_xIn_yGa_{1-x-y}N$, x, $y \geq 0$; $0 \leq x+y < 1$; $x > c$.

[Claim 15] 15. The LED of claim 13, further comprising:

a transparent conductive layer, disposed over the contact layer.

[Claim 16] 16. The LED of claim 13, wherein the contact layer comprises a strained layer superlattice (SLS), and the strained layer superlattice (SLS) comprises modulation doped $Al_uIn_vGa_{1-u-v}N/Al_xIn_yGa_{1-x-y}N$ quantum well structure, u, $v \geq 0$; $0 \leq u+v \leq 1$; x, $y \geq 0$; $0 \leq x+y < 1$; $x > u$.

[Claim 17] 17. The LED of claim 16, wherein the strained layer superlattice (SLS) is doped with an N-type dopant.

[Claim 18] 18. The LED of claim 16, wherein the strained layer superlattice (SLS) is doped with a P-type dopant.

[Claim 19] 19. The LED of claim 1, wherein the first electrode or the second electrode comprises Ti/Al, Ti/Al/Ti/Au, Ti/Al/Pt/Au, Ti/Al/Ni/Au, Ti/Al/Pd/Au, Ti/Al/Cr/Au, Ti/Al/Co/Au, Cr/Au, Cr/Pt/Au, Cr/Pd/Au, Cr/Ti/Au, Cr/TiWx/Au, Cr/Al/Cr/Au, Cr/Al/Pt/Au, Cr/Al/Pd/Au, Cr/Al/Ti/Au, Cr/Al/Co/Au, Cr/Al/Ni/Au, Pd/Al/Ti/Au, Pd/Al/Pt/Au, Pd/Al/Ni/Au, Pd/Al/Pd/Au, Pd/Al/Cr/Au, Pd/Al/Co/Au, Nd/Al/Pt/Au, Nd/Al/Ti/Au, Nd/Al/Ni/Au, Nd/Al/Cr/Au Nd/Al/Co/A, Hf/Al/Ti/Au, Hf/Al/Pt/Au, Hf /Al/Ni/Au, Hf/Al/Pd/Au, Hf/Al/Cr/Au, Hf/Al/Co/Au, Zr/Al/Ti/Au, Zr/Al/Pt/Au, Zr/Al/Ni/Au, Zr/Al/Pd/Au, Zr/Al/Cr/Au, Zr/Al/Co/Au, TiNx/Ti/Au, TiNx/Pt/Au, TiNx/Ni/Au, TiNx/Pd/Au, TiNx/Cr/Au, TiNx/Co/Au $TiWN_x$/Ti/Au, $TiWN_x$/Pt/Au, $TiWN_x$/Ni/Au, $TiWN_x$/Pd/Au, $TiWN_x$/Cr/Au, $TiWN_x$/Co/Au, NiAl/ Pt/Au, NiAl/Cr/Au, NiAl/Ni/Au, NiAl/ Ti/Au, Ti/NiAl/ Pt/Au, Ti/NiAl/ Ti/Au, Ti/NiAl/Ni/Au, or Ti/NiAl/Cr/Au.

[Claim 20] 20. The LED of claim 15, wherein the transparent conductive layer comprises Ni/Au, Ni/Pt, Ni/Pd, Ni/Co, Pd/Au, Pt/Au, Ti/Au, Cr/Au, Sn/Au, Ta/Au, TiN, $TiWN_x$ or WSi_x.

[Claim 21] 21. The LED of claim 15, wherein the transparent conductive layer comprises a N-type transparent conductive oxide layer or a P-type transparent conductive oxide layer.

[Claim 22] 22. The LED of claim 21, wherein the N-type transparent conductive oxide layer comprises ITO, CTO, ZnO:Al, $ZnGa_2O_4$, SnO_2:Sb, Ga_2O_3:Sn, $AgInO_2$:Sn or In_2O_3:Zn.

[Claim 23] 23. The LED of claim 21, wherein the P-type transparent conductive oxide layer comprises $CuAlO_2$, LaCuOS, NiO, $CuGaO_2$ or $SrCu_2O_2$.

[Claim 24] 24. The LED of claim 1, wherein the shunt diode comprises a Schottky diode.

[Claim 25] 25. The LED of claim 1, wherein the shunt diode comprises a Zener diode.

[Claim 26] 26. The LED of claim 1, wherein the shunt diode comprises a heterojunction diode.